Economic Resources and their Rotation.
Emergent Qualities of the Economy

Evgeny Petrovich VASILYEV
Siberian Federal University, Krasnoyarsk, Russian Federation
centrvnb@sibpsa.ru

Zoya Andreevna VASILYEVA
Siberian Federal University, Krasnoyarsk, Russian Federation
iubpe@sfu-kras.ru

Irina Vladimirovna FILIMONENKO
Siberian Federal University, Krasnoyarsk, Russian Federation
IFilimonenko@sfu-kras.ru

Svetlana Kapitonovna DEMCHENKO
Siberian Federal University, Krasnoyarsk, Russian Federation
demchenko.sv@yandex.ru

Tatyana Petrovna LIKHACHEVA
Siberian Federal University, Krasnoyarsk, Russian Federation
iubpe@sfu-kras.ru

Abstract:

The emergent nature of economic resources has been revealed, which determines the entire variety of processes of the initial resources consumption and restoration. An approach to determining the temporal potential of the existence of economic systems has been considered, based on their ability to self-renew their resources. The basic elements of converting some initial resource reserves to others have been determined, based on the system of preferences of individuals (their needs), which form a model for replacing the consumed initial resource reserves with restored resource reserves.

It has been proved that the processes of self-renewal of the initial resource reserves are both consumption of these reserves and their restoration. As a result, all economic processes that occur in the society are presented in this article as ultimate target cycles of self-renewal of the initial reserves of all types of reproducible resources available in the economy.

It has been noted that the emergent quality of the initial resource reserves (their ability to self-renew) arises only for the special matrix structure of these resource reserves. It has been established that the emergent reserve of marginal target cycles of self-renewing the initial reserves of reproducible resources in the economic system is always limited due to the division of resources into reproducible and nonreproducible.

From these positions, the economic system can control the potential time of its existence, depending on the choices made by participants in economic processes. The need for the formation of a special economic mechanism aimed at maintaining and expanding the potential existence of the economic system through the development of matrix technologies for self-renewal of the initial reserves of reproducible resources is substantiated in the article.

The methodological basis of the study is presented by methods of analysis and synthesis, theory of sets, and economic and mathematical modeling.

Keywords: resources; utility; self-renewal; limit target cycles; cyclo-temporal dimension; economic systems.

Introduction

Economic science has paid considerable attention to the study of the nature of economic resources throughout all the historical stages of its development. The focus is made on the main, systemic (emergent) (Note 1) characteristics of economic resources in the article.

The goal of the article is to study the emergent qualities of the economy as a whole, which will reveal the special matrix structure of the reserves of economic resources, ensuring the possibility of self-renewal and the ability of economic agents to influence the potential time of the existence of the economic system. The study of the emergent qualities of the economy as a whole will allow to deepen theoretical ideas about the nature of the basic concepts of economic theory.

First of all, this refers to the understanding of the underlying nature: prices, costs and utility of resources; money and monetary relations; economic growth; optimal conditions both for the economy *as a whole* and its elements.

The direct statements of the world-famous economists testify to the need for such economic research. For example, Nobel Prize laureate Friedman (1991, 27) states: 'Little has changed in the main problems that have attracted the attention of economists: these problems are essentially the same that Adam Smith dealt with 200 years ago. Moreover, there have been no dramatic changes in our understanding of these problems'.

Regarding the prices for resources and monetary relations, the eminent theoretical economist E. Malinvaud evaluates the situation that has developed in the modern economic science as follows: 'In the economy under consideration, prices are determined accurate to a constant factor and can be measured by the amount of any good taken as a unit account. Such an economy is often called calculative. In reality, prices are expressed in monetary units. The economic science should explain how their absolute level changes, i.e., how the purchasing power of money changes, since this change entails numerous consequences. However, microeconomic theory cannot yet be directly used to solve this problem at the present stage of development' (Malinvaud 1985, 20).

Many other well-known economists agree. For example, Nobel laureate Arrow (1974, 5) notes: 'When I was in my final year at the university, the trend was to taunt the medieval idea of 'fair price' (none of the today's students has ever heard about it or any other theory that dates thirty years ago); but a glimpse into any modern journal will find articles on pricing to determine economic efficiency, where modern versions of the same idea are laid out'.

The lack of synthesis of microeconomic and macroeconomic theories also indicates an insufficient level of theoretical development of the fundamental basic concepts of the economic theory. In this regard, K.J. Arrow writes: 'The relationship between micro- and macroeconomics is one of the most important problems of the modern economic theory of general equilibrium, which still have not been solved' (Arrow 1993, 56). Hodgson highlighted the problem of combining micro- and macroeconomics as a 'puzzle of economic theory' (Hodgson 1996, 60).

Nobel laureate R. Selten notes the paradox of the situation that exists in the economic theory: 'Like some other economists, I feel discomfort from majestic constructions on a shaky foundation' (Polterovich 1998, 55).

The 'shakiness of the foundation' on which 'majestic constructions rise' may indicate that there are no fundamental theoretical links in the economic theory that reflect the *systemic, integral* (emergent) characteristics of the market economy *as a whole*. These systemic characteristics are at the basis of market pricing, and therefore of the 'invisible hand' of the market mechanism.

The authors rely on the general scientific methodological idea, which consists in the fact that 'for any field of science, the provision holds that we always return to the source from which all science arises. This is the concept of integrity' (Planck 1966, 197). However, in the labor and marginalist theories of the cost and price of resources, the focus is not on the integrity (emergence) or the systemic characteristics of the market economy as a whole, but on its individual elements (*labor* in the theory of labor value and *utility of certain* goods or sets of consumer goods for *certain* individuals in the theory of utility).

As such, the authors believe that a focused study of the emergent characteristics of the economy *as a whole* is vital for building a logically consistent, holistic, and monistic economic theory.

Economic goods or resources are primarily certain physical or biological objects (things, properties, services, etc.) – for example, bread, milk, a TV set, a car, electricity, transport services, labor, etc. There are hundreds of thousands and even millions of different types of resources in the economy today that differ in the degree of their aggregation (Malinvaud 1985, 16).

Each economic resource as a physical or biological object always exists as a certain reserve at any given moment in time t measured by the corresponding natural material metrics: kg, pieces, meters, machine-hours,

man-hours, kWh, etc. However, economic resources are not just reserves of any physical and biological objects, they are designed to satisfy a wide variety of human needs (production and personal) (Jevons 2000).

In this regard, economic resources are physical and biological objects able to satisfy human needs or correspond to these needs. This property (to meet the needs) was called the *utility* of resources. Resources that correspond to needs are useful, and those that do not correspond to them are useless (Viener 2000).

Human needs are no less diverse than resources to satisfy them. In a first approximation, human needs are special target models that are generated by individuals and are designed to reflect or represent reserves of various types of resources *preferred* by individuals.

1. Methods

To describe the emergent qualities of the economic system and the features of the circulation of its resources, the methods of the theory of sets will be used, and all types of resources will be represented as a multitude of reserves of these resources at the disposal of all individuals. At some current point in time t, these resource reserves will be *initial* reserves, and the moment of time t will be the *initial* moment of time t_i. Let us denote the set of initial resource reserves as R^{t_i}.

The set R^{t_i} includes not only certain physical and biological objects, but also all types of services, including all types of labor services (labor resources). For simplicity, all types of resource reserves included in the set R^{t_i} are called *physical* resource reserves for simplicity.

In general terms, the needs are target information *models* of resource reserves, and the initial current needs (denoted as $R_d^{t_i}$) are purely information target models that reflect *future* levels of actual initial physical resource reserves *preferred* by individuals.

Physical reserves of resources R^{t_i} and their target models $R_d^{t_i}$ reflecting the preferred *future* technologically possible physical state of resource reserves R^{t_i} represent *sets*. The set R^{t_i}, like the set $R_d^{t_i}$, consists of qualitatively different elements – the reserves of individual types of resources. When comparing R^{t_i} and $R_d^{t_i}$, the authors assume that they have equal number of elements. This means that if, for example, some element is in the *actual* composition of the set $R_d^{t_i}$ but is not in the *actual* composition of the set R^{t_i}, then it is assumed that this element exists in the set R^{t_i}, but its reserves in R^{t_i} equal to *zero*. Any other multitude of resources and needs are brought into comparable form in this way.

Any economic system at a certain initial moment of time t_i is always described as a system of initial physical reserves of different types of resources R^{t_i} and as a system of initial needs of individuals $R_d^{t_i}$. All values from the set $R_d^{t_i}$ can actually be obtained in *physical* terms or realized only at some point in time t in the future. This moment of time in the future is called the *finite* moment and denoted as t_f. In this case, the level of physical reserves of resources at the point t_f (such reserves are denoted as R^{t_f}) will correspond to the initial needs $R_d^{t_i}$, i.e., $R^{t_f} = R_d^{t_i}$. Let us call the physical reserves of resources at the point t_f the *finite* reserves. As such, the initial needs $R_d^{t_i}$ are the target information models of *future* preferred current physical reserves of resources at the point t_f, or future preferred finite resource reserves R^{t_f}.

The difference between time points $t_f - t_i = \Delta t$ forms a period of time. Theoretically, this time interval Δt can be infinitesimal. However, there always exists some extremely minimal *finite* small time interval Δt – for example, Δt = one day or one hour, etc., rather than an infinitesimal time interval $\Delta t = l \rightarrow 0$. Such a *finite small* period $\Delta t = l$ is the limit time interval.

The relationship between the *physical* resource reserves R^{t_i} and their *target* (preferred) reserves $R_d^{t_i}$ or needs may be different. Let us denote one element in the sets R^{t_i}, R^{t_f} and $R_d^{t_i}$ as i. Let $i = 1, \dots, z$, where z denotes not only the z-th element in the desired sets, but also indicates the total number of elements in each of these sets (Note 2). If for each element in these sets their values are equal to $R_{d_i}^{t_i} = R_i^{t_i}$ for all i, then satisfying current needs in their entirety leads to a simple self-renewal of the initial resource reserves when $R^{t_f} = R^{t_i}$. If the level $R_{d_i}^{t_i} < R_i^{t_i}$ for some or all i, then the satisfaction of the current needs in their entirety leads to self-renewal of the initial resource reserves in decreasing volumes when $R_i^{t_f} < R_i^{t_i}$ for some or all i.

If the level of current physical reserves of resources R^{t_i} is less than their level recorded in the current needs $R_d^{t_i}$, $R_i^{t_i} < R_{d_i}^{t_i}$ for some or all i, then the full satisfaction of the current needs leads to self-renewal of the initial resource reserves in expanding volumes when $R_i^{t_f} > R_i^{t_i}$ for some or all i.

The authors distinguish between *subjective* and *objective* desires or needs of individuals. Objective needs are largely based on the actual physical reserves of all types of resources that exist in the economy at any given initial moment of time t_i, as well as on the set of well-established production technologies that can be used to transfer the current reserves of all types of resources existing at time t_i to large or qualitatively better reserves of all resources that will exist at time t_f in the future.

In order for all needs (all values in the set $R_d^{t_i}$) to be real, i.e., able to materialize, rather than to be just abstract fantastic desires, they should be based on the set of *really* possible physical *finite* resource reserves R^{t_f}. This means that the initial needs $R_d^{t_i}$ can at the initial moment of time t_i *intentionally* and *inversely* reflect *one of the many* possible, technologically feasible *future* structures of the finite resource reserves R^{t_f}, $R_d^{t_i} = R^{t_f}$. As such, the *real current* needs $R_d^{t_i}$ can be satisfied *in full* for one *limit* period of time $\Delta t = l$.

For a limit finite small period of time $\Delta t = l$, the initial reserves of resources R^{t_i} will be consumed and hence decrease. Therefore, resource reserves R^{t_i} are physically transformed into resource reserves R^{t_f}. Let us denote such volumes of consumption of all initial resource reserves for $\Delta t = l$ as V_c^l. It is also true for the set V_c^l that it consists of the set of elements V_{ci}^l, $i = 1, \dots, z$.

Since the transfer of resource reserves R^{t_i} into resource reserves R^{t_f} is a productive process, i.e., it is carried out using many well-established production technologies, then a decrease (consumption) of the initial resource reserves will be at the same time accompanied by the opposite process – an increase or restoration of these initial resource reserves. Let us denote the set of volumes for the restoration of initial resource reserves for:

$\Delta t = l$ as V_R^l; $V_{R_i}^l$, $i = 1, \dots, z$.

Then,

$$R^{t_f} = R^{t_i} - V_c^l + V_R^l, \tag{1}$$

Hence,

$$V_R^l = R^{t_f} - R^{t_i} + V_c^l. \tag{2}$$

If it is taken into account that the actual volume of consumption of resource reserves V_c^l is usually less than the initial reserves of these resources R^{t_i}, $V_{c_i}^l < R_i^{t_i}$ for all or some i, then the difference:

$$R^{t_i} - V_c^l = R^{t_{in}} \tag{3}$$

represents a set of *non-consumed* volumes of initial resource reserves for $\Delta t = l$. Then,

$$R^{t_f} = R^{t_{in}} + V_R^l \tag{4}$$

and

$$V_R^l = R^{t_f} - R^{t_{in}}. \tag{5}$$

Models (4) and (5) are completely equivalent to models (1) and (2), i.e.

$$R^{t_f} = R^{t_i} - V_c^l + V_R^l = R^{t_{in}} + V_R^l \tag{6}$$

and

$$V_R^l = R^{t_f} - R^{t_i} + V_c^l = R^{t_f} - R^{t_{in}}. \tag{7}$$

Naturally, it is always assumed that the number of elements in each of the sets: R^{t_f}, R^{t_i}, $R^{t_{in}}$, V_c^l, and V_R^l is equal, $i = 1, \dots, z$.

It is also assumed that resource reserves V_c^l are consumed *continuously* in the economic system for any infinitesimal time intervals $\Delta t = l \rightarrow 0$. At the same time, the volumes of restoration of resource reserves V_R^l appear or are formed *discretely* in the economic system; in particular, only in *finite* points t_f of each limit finite small time interval $\Delta t = l = t_f - t_i$. As such, the authors assume that the limit time interval $\Delta t = l$ is not infinitesimal but

is finite – for example, one day. If it is assumed that $\Delta t = l \rightarrow 0$ also for restoration of the resource reserves V_R^l, then both resource consumption and restoration will occur *continuously* in the economic system.

The authors will further always proceed from the fact that both for describing the limit volumes of resource reserves consumption V_c^l and for describing the limit volumes of resource reserves restoration V_R^l, the time interval Δt will be a certain *single* limit minimal period $\Delta t = l$ of the *limit small* rather than *infinitesimal* dimension.

Let us call the needs reflecting *future* volumes of the resource reserves *restoration* the *activated* needs and denote them as $R_{Ad}^{t_i}$. In this case, $V_R^l = R_{Ad}^{t_i}$. This means that the total value of activated initial needs $R_{Ad}^{t_i}$ represents the *target model of future* volumes of restoring initial resource reserves V_R^l, which replace the consumed volumes of initial resource reserves V_c^l for $\Delta t = l$.

Actual volumes of restoring initial resource reserves V_R^l may differ in the composition of resources and usually differ from the composition of resources in *actual* volumes of consuming initial reserves V_c^l. Therefore, it should be assumed that all elements present in one actual set V_R^l, but not present in the other actual set V_c^l, and vice versa, have *zero* values in the actual sets where they are not present, i.e., they are present, but always with zero values.

Following from the above, the entire set of economic processes in the economy *as a whole* can be represented as a *target* transition of the set of initial resource reserves and needs from one current state at the point t_i, R^{t_i}, $R_d^{t_i}$ to another current state at the point t_f, R^{t_f}, $R_d^{t_f}$. This target transition is *limit* in the sense that it occurs for $\Delta t = l = t_f - t_i$.

The required limit target transitions of the current initial resource reserves and needs are nothing more than the limit *target cycles* of the physical *self-renewal* of these current initial reserves of all types of resources and needs. Any limit cycle of self-renewal of the initial resource reserves and needs *begins* at point t_i with the *consumption* of these initial resource reserves R^{t_i} and with the *materialization* of the initial activated needs $R_{Ad}^{t_i}$ and *ends* at point t_f with *full materialization* or full satisfaction of the activated initial needs $R_{Ad}^{t_i}$ and the *complete replacement of the consumed* volumes of the initial resource reserves V_c^l for the restored volumes of the initial resource reserves V_R^l, as well as the *replacement* of the previous ones *already satisfied* with activated initial needs $R_{Ad}^{t_i}$ for the *new* (restored) activated initial needs $R_{Ad}^{t_f}$.

The *process of self-renewal* of the initial resource reserves and needs is, on the one hand, a process of *consuming* (reducing) these initial resource reserves and a process of satisfying (decreasing) the initial activated needs. On the other hand, it is a process of *restoring*, and in this regard, increasing the initial resource reserves, and the process of *forming*, and in this regard, restoring and increasing the new activated initial needs.

The limit target cycles of physical self-renewal of the initial resource reserves and needs can be represented in a formalized form as the following functional mappings:

- The limit cycles for the *full satisfaction* of the initial needs of all individuals $R_d^{t_i}$ and the initial activated needs of all individuals $R_{Ad}^{t_i}$, or the limit cycles of *full objectification* of the initial *target* models $R_d^{t_i}$ and $R_{Ad}^{t_i}$ are as follows:

$$f : R_d^{t_i} \rightarrow R^{t_f} \text{ for } R^{t_f} = R_d^{t_i} \text{ and } f : R_{Ad}^{t_i} \rightarrow V_R^l \text{ for } V_R^l = R_{Ad}^{t_i}.$$

- The limit physical cycles of self-renewal of the initial resource reserves of all individuals are as follows:

$$f : R^{t_i} \rightarrow R^{t_f} \tag{8}$$

and

$$f : V_c^l \rightarrow V_R^l. \tag{9}$$

It must be taken into account that the transformation of the initial resource reserves R^{t_i} into the finite reserves R^{t_f} and the transformation of the limit volumes of consumption V_c^l into the limiting volumes of restoration V_R^l are not unique. This means that the mappings (8) and (9) exist as the corresponding mappings of structures R^{t_i} and V_c^l into the sets P' and P of the possible structures R^{t_f} and V_R^l, i.e.

$$f : R^{t_i} \rightarrow P'(R^{t_f}) \tag{10}$$

and

$$f\colon V_c^l \to P(V_R^l). \tag{11}$$

Special variables are used in economic systems to compress the sets P and P' into the corresponding points and get the mappings (10) and (11) as unambiguous – target models (needs) reflecting future finite resources preferred by individuals. In this case, mappings (10) and (11) will take the form of models (12) and (13).

- ▪ The limit target cycles of physical self-renewal of the initial resource reserves for all individuals are represented as processes where variables R^{ti} and $R_d^{t_i}$ are displayed in R^{t_f}:

$$f\colon \left[R^{ti},\ R_d^{t_i}\right] \to R^{t_f} \text{ or } R^{t_f} = f\left(R^{ti},\ R_d^{t_i}\right), \tag{12}$$

while variables V_c^l and $R_{Ad}^{t_i}$ are displayed in V_R^l:

$$f\colon \left[V_c^l, R_{Ad}^{t_i}\right] \to V_R^l \text{ or } V_R^l = f\left(V_c^l, R_{Ad}^{t_i}\right). \tag{13}$$

If $V_c^l = R^{ti}$, then $R^{t_f} = V_R^l$ and $R_{Ad}^{t_i} = R_d^{t_i}$. In this case, models (12) and (13) completely match. If $V_{ci}^l < R_i^{t_i}$, then $R_i^{t_f} > V_{Ri}^l$ and $R_{d_i}^{t_i} > R_{Adi}^{t_i}$ for all or some i. In this case, models (12) and (13) will be different. Model (13) is more general than model (12), because it contains it as a special case when $V_c^l = R^{ti}$, $V_R^l = R^{t_f}$ and $R_{Ad}^{t_i} = R_d^{t_i}$.

Since any limit target cycle of physical self-renewal of the initial resource reserves R^{ti} and the initial activated needs $R_{Ad}^{t_i}$ ends with the *restoration* not only of the *consumed physical* volumes of the initial resource reserves, but also with the *restoration* of the satisfied (objectified) initial activated needs at the point t_f, this economic process can be represented as the following functional mapping – as a function of self-renewal of initial resource reserves and initial activated needs.

In a formalized general form, the systemic economic function of self-renewal of the initial resource reserves and needs will be as a following mapping:

$$f\colon \left[V_c^l, R_{Ad}^{t_i}\right] \to \left[V_R^l, R_{Ad}^{t_i}\right] \tag{14}$$

or with equality of $V_c^l = R^{ti}$ and $R^{t_f} = V_R^l$

$$f\colon \left[R^{ti}, R_d^{t_i}\right] \to \left[R^{t_f}, R_d^{t_f}\right]. \tag{15}$$

At the same time, the temporal finite point t_f is the starting point t_i for the cycle following the current cycle of self-renewal of the initial resource reserves and needs. Let us denote the time-consecutive numbers for the current cycles of self-renewal of the initial resource reserves and needs as a, then $a = 1, \dots, \infty$ will denote the time-consecutive limit target cycles of self-renewal of the initial resource reserves and needs.

In this case, models (14) and (15) will be as follows:

$$f\colon \left[V_c^{la},\ R_{Ad}^{tai}\right] \to \left[V_R^{la},\ R_{Ad}^{taf}\right] \tag{16}$$

Or for $V_c^{la} = R^{tai}$ and $R^{taf} = V_R^{la}$

$$f\colon \left[R^{tai},\ R_d^{tai}\right] \to \left[R^{taf},\ R_d^{taf}\right]. \tag{17}$$

Since $R^{ta+1i} = R^{taf}$, $R_d^{ta+1i} = R_d^{taf}$ and $R_{Ad}^{ta+1i} = R_{Ad}^{taf}$ then,

$$f\colon \left[V_c^{la},\ R_{Ad}^{tai}\right] \to \left[V_R^{la}, R_{Ad}^{ta+1i}\right] \tag{18}$$

and

$$f\colon \left[R^{tai},\ R_d^{tai}\right] \to \left[R^{ta+1i}, R_d^{ta+1i}\right]. \tag{19}$$

Technically, the set of needs R_{Ad}^{ta+1i} is a function (map) not of the quantities R^{tai} and R_{Ad}^{tai}. The set of needs R_{Ad}^{ta+1i} is based on the set of technologically feasible *future structures* of the volumes of restoration of the initial resource reserves V_R^{la+1} in the $a + 1$-th limit cycle of self-renewal of the initial resource reserves. If $R^{ta+1f} = V_R^{la+1}$, then R_{Ad}^{ta+1i} is based on the set R^{ta+1f}. The details of forming needs R_{Ad}^{ta+1i} and what it depends on will be

omitted for now. It must also be noted that the formation of a specific system of needs $R_{Ad}^{t_{a+1}i}$ is associated with the mechanism of choosing any one *separate preferred* structure $V_R^{l_{a+1}}$ or structure $R^{t_{a+1}f}$ from the set of such possible *future* structures $P\left(V_R^{l_{a+1}}\right), P'\left(R^{t_{a+1}f}\right)$, which are potentially contained in the final structure of the resource reserves $R^{t_{af}}$ at the finite moment of time $t_{af} = t_{a+1i}$ of the a-th limit cycle.

Let us denote the pattern or law of selecting any one preferred structure $V_R^{l_{a+1}}$ and $R^{t_{a+1}f}$ from the set P of such possible structures as L, then the structure of needs will be as follows:

$$R_{Ad}^{t_{a+1}i} = L\left[P\left(V_R^{l_{a+1}}\right)\right],$$

or for the case when $R^{t_{a+1}f} = V_R^{l_{a+1}}$,

$$\frac{R^{t_{a+1}i}}{R_{Ad}} = R_d^{t_{a+1}i} = L\left[P'\left(R^{t_{a+1}f}\right)\right].$$

Then model (1.19) will be as follows:

$$f: \left[R^{t_{ai}}, R_d^{t_{ai}}\right] \rightarrow \left\{R^{t_{a+1}i}, R_d^{t_{a+1}i} = L\left[P'\left(R^{t_{a+1}f}\right)\right]\right\}. \tag{20}$$

If sets $\left[R^{t_i}, R_d^{t_i}\right]$ are denoted as X^{t_i}, and sets $\left[R^{t_f}, R_d^{t_f}\right]$ as X^{t_f}, then models (19) and (20) can be represented as $f: X^{t_i} \rightarrow X^{t_f}$ and $f: X^{t_{ai}} \rightarrow X^{t_{a+1}i}$.

2. Research Results

Limit cycles of self-renewal of initial resource reserves and needs. Models (19) and (20) reflect the *target* transition of the set of initial resource reserves and the set of initial needs from their current state at t_{ai} to their current state at $t_{af} = t_{a+1i}$ for a limit period of time $\Delta t = l = t_f - t_i$. Such limit transitions are limit target cycles of self-renewal of initial resource reserves and needs. As such, regarding the limit cycles of self-renewal of the initial resource reserves, it is always meant that not only the *physical* initial resource reserves self-renew, but also the initial real *needs* do, or the initial *target models* generated by all individuals participating in all economic processes.

If the set of needs $R_d^{t_{a+1}i} = R_d^{t_{ai}}$ for all a, then it will be a process of *simple* self-renewal of the initially set current resource reserves $R^{t_{ai}}$ and needs $R_d^{t_{ai}}$. If $R_d^{t_{a+1}i} \neq R_d^{t_{ai}}$ for all a, then the economic system will transit from one of its current technological cyclo-temporal niches to another technological cyclo-temporal niche in the process of self-renewing its initial resource reserves. The period of existence of the economic system, or the reserve of limit target cycles of self-renewing its initial resource reserves, is always limited in each of these technological cyclo-temporal niches.

One should also proceed from the fact that all the required marginal cycles for updating the initial resource reserves and needs are *self*-renewal cycles, since all *target models* (needs) are generated by the *very* system of initial resource reserves R^{t_i}, namely *human* resources, which are part of any set R^{t_i}.

The matrix structure as a systemic characteristic of the initial resource reserves. It must be especially noted that the ability of an economic system to self-renew the target initial resource reserves that circulate or function in it is an *emergent* quality of only *combined* resources. Not a single type of resource in itself, and even isolated separate groups of resources, are able to self-renew their reserves. This ability is *emergent* and involves a clearly defined *matrix* form or organization structure of any initial reserves of all types of resources (Note 3).

The *matrix structure* of the initial resource reserves is purely systemic characteristics of any *individual* types of resources. These individual initial reserves of certain types of resources are primarily the integral parts of the *matrix* of initial resource reserves capable of targeted *self-renewal*. Only the initial reserves of *combined* resources, which are structured as a *matrix* of initial reserves, are capable of their targeted self-renewal.

In this regard, the initial reserve of limit target cycles of self-renewal of the initial resource reserves is also an *emergent* or *systemic* characteristic of any economic system *as a whole*. In other words, this reserve of the economy's cyclo-time of existence is a property (quality) only of *combined* types of initial resource reserves.

Finitute of limit cycles of self-renewal of the initial resource reserves. It may seem that the desired limit target transitions or the limit cycles of target self-renewal of the initial resource reserves and needs can continue indefinitely, and that the initial reserve of such limit cycles of self-renewal of the initial resource reserves and needs available in the economic system at each given initial moment of time t_i *is not limited by anything* and is equal to an infinitely large value. However, this is not the case. The authors claim that the *initial reserve* of limit cycles of target self-renewal of the initial resource reserves and needs possessed by any economic system at any given time

t_i is always limited. This is due to the fact that the set of all initial resource reserves R^{t_i} is divided into two *fundamentally* different subsets, in the first place: a subset of *reproducible* resources denoted as *RR* and a subset of *nonreproducible* resources denoted as *NR*.

Two types of resources of the economic system: reproducible and nonreproducible. The definition of an economic system as a process of target self-renewal of the initial resource reserves, described by the corresponding self-renewal function $f: X^{t_i} \to X^{t_f}$, immediately draws attention to the fact that not all resources required for the economy are reproducible at a given technological level. The so-called natural resources are nonreproducible. At the current level of technological development of the economy, these are primarily minerals: oil, gas, coal, peat, metals, etc. Water, solar energy, land, and its area (territory) are also considered nonreproducible. Some resources, though reproducible or poorly reproducible, are nonetheless reproduced without the participation of the economic system. Therefore, from the standpoint of the process of self-renewing the initial resource reserves $f: X^{t_i} \to X^{t_f}$, they will also be nonreproducible, since they are not a *product* of the economic system itself. These include air, soil, partly forests, and bioresources of the oceans or wild flora and fauna in general. The reproduction of such resources by nature itself costs nothing to the economic system.

The entire set of initial reserves of all types of resources R^{t_i} is divided into two subsets. A subset of reproducible resources (*RR* resources) and a subset of nonreproducible resources (*NR* resources). *Reproducible* resources are those *consumed*, *produced* (manufactured), and *restored* or *replacing* previously consumed volumes of initial resource reserves within the economic system. *Nonreproducible resources* are those only *consumed* by the economic system, but not produced or restored.

The economic system as a matrix of initial reserves of reproducible resources. It follows from the above provisions that any economic system is a *matrix* of initial reserves of *reproducible* resources intended for target self-renewal; such a matrix is denoted as $R_S^{t_i}$. Being an economic system, economics itself is a process of target self-renewal of the initial reserves of reproducible resources $f: X^{t_i} \to X^{t_f}$. However, it is clear that this process, like any other, has an external environment, which is also a set (reserve) of physical elements or conditions required for the processes of self-renewal $X^{t_i} \to X^{t_f}$. In this regard, nonreproducible resources can be called resources of the external environment.

Influence of nonreproducible resources of the external environment on the cycles of self-renewing the resources of the economic system. The entire set of *resources of the external environment* is, in turn, divided into two parts (subsets). The first part, or a subset of nonreproducible resources (denoted as NR_1), is directly used by the economic system. This means that the matrix of initial reserves of reproducible resources $R_S^{t_i}$ in each limit cycle of its self-renewal always *consumes* some volumes of NR_1 resources from their total initial current reserve.

Many initial reserves of NR_1 resources directly interact with the matrix of *RR* resources $R_S^{t_i}$ and are *consumed* only. Moreover, the consumption of initial reserves of NR_1 resources is a necessary condition for obtaining any *production* of *RR* resources, and, consequently, for the implementation of the process of self-renewing the *RR* resources $X^{t_i} \to X^{t_f}$. At each given moment of time t, all NR_1 resources appear in the form of a definite, always limited and nonreproducible initial economic reserve by the economic system or as always limited initial reserves constantly reproduced by the external environment or nature.

The second part, or a subset of nonreproducible resources (NR_2 resources), represents initial reserves of physical elements and conditions of the external environment which do not *directly* interact with the system or the matrix of initial reserves of *RR* resources $R_S^{t_i}$ and are not *consumed* by it during the self-renewal of these initial resource reserves. It can be stated that the reserves of NR_2 resources are *technologically neutral* in regard to the process of self-renewal of *RR* resources. NR_2 resources are primarily outer space surrounding the Earth and terrestrial physical objects not directly used by the economy.

The extracted oil, gas, ore, caught animals, fish, and other seafood, cut down wild forest and harvested berries, etc. technically are reproducible resources, since they are consumed, produced, and restored in the process of self-renewal of resources. Forest and its products 'in the bud', free fish in a river or in the sea, minerals in the earth's crust, etc. are all reserves of resources that are consumed only, and therefore are nonreproducible NR_1 resources for the economic system.

In turn, all reserves of NR_1 resources, the consumption of which is *required* for the economy operation, are divided into two groups. *The first group* of such reserves is denoted as NR_1^1 resources and is *freely available* for consumption by the relevant economic cells of the economic system. Free access to the consumption of these reserves of NR_1^1 resources is limited only by the capacities of the extractive industries.

The second group of reserves of NR_1 resources is denoted as NR_1^2 resources and is not *freely available* for consumption. For these reserves of NR_1^2 resources, free access to their consumption is severely limited or even impossible due to the existence of *purely technological* limitations. In this case, the total initial reserve of each type of NR_1 resource is as follows:

$$NR_{1f} = NR_{1f}^1 + NR_{1f}^2; f = 1, \dots, s$$ – number of types NR_1 resources.

At the current level of developing engineering and technology, the extraction of reserves of NR_{1f}^2 resources for all (f) is either not possible at all, as it used to be relatively recently with the production of *shale* oil and gas, for example, or very expensive. Extracting NR_{1f}^2 resources is inefficient. Under these conditions, the economic system begins to shrink with all the ensuing negative consequences.

The authors believe that the initial reserves of NR_{1f}^1 resources with free access are usually more limited in comparison with the initial reserves of NR_{1f}^2 resources with nonfree access. It must also be noted that from the set of all types of initial reserves of NR_{1f}^1 resources (vector $\left\{ R_f^{t_i^{NR_1^1}} \right\}$), there are separate types or whole groups of reserves of NR_{1f}^1 resources for some (f), which are *limiting* for the economy. The reserves of limiting NR_{1f}^1 resources, *given* the most important initial parameters of the economy, are exhausted prior to other types of initial reserves of NR_1^1 resources.

If one theoretically imagines that all the resources consumed within the economic system as a whole are *reproducible*, i.e., being restored, then such a system can exist forever, like a perpetual motion machine. No such systems exist in nature, and the economic system in this regard is no exception.

All initial reserves of all types of resources R^{t_i}, which are used (consumed) in the economic system, are divided into reproducible resources and nonreproducible resources. It follows from this that the initial reserve of limit target cycles of self-renewal of the initial reserves of reproducible resources $R_S^{t_i}$ at each given time t_i is *always limited*. The authors call this limited reserve of marginal cycles of self-renewal of the initial reserves of *RR* resources the initial *technological* cyclo-temporal reserve and denote it as TCTR^{t_i}.

The division of all resources involved in the economic process into reproducible (*RR*) and nonreproducible (*NR*), as well as their corresponding limited initial reserves determine the existence of clear boundaries of the initial technological cyclo-temporal potential of the economic system. Living labor (human resource) was the first (and for some time the only) reproducible resource of the economic system. The remaining resources were those of the external environment, or nonreproducible. Along with the development, the composition of reproducible resources expanded, their structure became more complicated, and former nonreproducible resources became reproducible. Such a movement is associated with the representation of economic systems as a special kind of systems that are able to move and change the potential time of its existence.

Conclusions and Further Research

Although no systems can exist forever, this circumstance does not prevent the authors from assuming that there are systems seeking for eternal existence as some unattainable goal. In any case, this desire contributes to the expansion or preservation of the initial temporal potential for the existence of such systems. The authors believe that the current market economic system belongs to this class of systems seeking to preserve and increase the initial cyclo-temporal potential of their existence.

The most diverse initial resource reserves and the corresponding specialized technologies for resource production and consumption are contracted in the economic system and compressed into one dimension – cyclo-temporal. All input resources in such a system (including a cyclo-temporal resource) are its output resources, and vice versa (except for *NR* resources and waste).

The temporal boundaries of the existence of an economic system depend on the level of its initial cyclo-temporal reserve, which, in turn, depends on the level of initial matrix reserves of resources and the level of initial reserves of nonreproducible resources. The issues of what exactly the matrix structure of the initial reserves of resources looks like and how it affects the always limited initial reserve of the economy's life cycle require additional scientific research.

Studying the emergent qualities of the economy as a whole, undertaken in this article, will allow gaining deeper understanding of the internal structure of any economic system, revealing its matrix structure and always limited temporal (cyclo-temporal) potential of its existence.

Investigating the limited temporal (cyclo-temporal) potential of economy existence as a whole and the laws of its movement will allow revealing the still unknown fundamental basis and laws of pricing for any kinds of resources, as well as allow deepening theoretical ideas about the nature of money and all monetary (financial) relations that exist in a market economic system.

Notes:

Note 1. Emergence is the availability of integrity properties (emergent properties) in the system (in this case, the system of all kinds of resources), i.e., properties that are not inherent in its constituent elements (various types of resources) *individually*. These properties are inherent to all the *combined* elements of the system only (all types of resources).

Note 2. It must be reminded that the composition of sets R^{t_i}, R^{t_f}, and $R_d^{t_i}$ includes not only reserves of purely natural types of resources, but also reserves of labor resources.

Note 3. The exact look of this matrix structure of initial reserves of all types of resources and needs is the subject of a special research. In this analysis, this matrix structure of the initial and final reserves of resources and needs is presented in a generalized form, namely in the form of the following sets: R^{t_i}, R^{t_f}, V_c^l, V_R^l, $R_d^{t_i}$, $R_d^{t_f}$, $R_{Ad}^{t_i}$, $R_{Ad}^{t_f}$.

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